**Intermediate Algebra**
**Skill-Builder # AE - 2**
**Applying Exponent Rules Involving Products and Powers**

Following are the exponent rules for products and powers.

$$a^n \cdot a^m = a^{n+m} \qquad (1)$$

$$\left(a^n\right)^m = a^{nm} \qquad (2)$$

$$\left(ab\right)^n = a^n b^n \qquad (3)$$

Examples

The following show how rule (1) is used:

**1.** $2^2 \cdot 2^3 = 2^{2+3} = 2^5 = 32$

**2.** $x^2 \cdot x^4 \cdot x^8 = x^{2+4+8} = x^{14}$

**3.** $x^3 \cdot x^2 \cdot y^4 \cdot y \cdot z \cdot z = x^{3+2} \cdot y^{4+1} \cdot z^{1+1} = x^5 y^5 z^2$

**4.** $a^3 bc^3 \cdot ab^4 c^6 = a^3 a \cdot bb^4 \cdot c^3 c^6 = a^4 b^5 c^9$

The following show how rule (2) is used:

**5.** $\left(2^2\right)^3 = 2^{2 \cdot 3} = 2^6 = 64$

**6.** $\left(c^4\right)^9 = c^{4 \cdot 9} = c^{36}$

**7.** $\left(n^2\right)^5 \left(p^4\right)^4 = n^{2 \cdot 5} p^{4 \cdot 4} = n^{10} p^{16}$

The following show how rule (3) is used:

**8.** $\left(2x\right)^5 = 2^5 x^5 = 32x^5$

**9.** $\left(3abx\right)^4 = 3^4 a^4 b^4 x^4 = 81a^4 b^4 x^4$

The following show how rules (1) - (3) are used in one problem:

**10.** $2x^4 y \left(3xy^3\right)^2 = 2x^4 y \cdot 3^2 x^2 \left(y^3\right)^2$

$$= 2x^4 y \cdot 9x^2 y^6$$

$$= 2 \cdot 9 \cdot x^4 x^2 \cdot yy^6$$

$$= 18x^6 y^7$$

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Simplify.

**1.** $3^2 \cdot 3 \cdot 3^9$ (Leave answer in exponential form.)

**2.** $4^2 \cdot 4 \cdot 4 \cdot 4^4$ (Leave answer in exponential form.)

**3.** $x \cdot x^2 \cdot x^3$

**4.** $y^7 \cdot y^3 \cdot y$

**5.** $2a \cdot 2^3 a^2 \cdot 2a^3$

**6.** $-b^3 \cdot 5b^2 \cdot 2b^4$

**7.** $\left(t^5\right)^6$

**8.** $\left(m^2\right)^{10}$

**9.** $\left(x^3\right)^3 \left(y^2\right)^5$

**10.** $\left(y^4\right)^3 \left(w^5\right)^7$

**11.** $\left(a^2\right)^4 \left(a^3\right)^2$

**12.** $\left(p^7\right)^3 \left(p^2\right)^9$

**13.** $\left(5ab\right)^2$

**14.** $\left(3xy\right)^3$

**15.** $\left(2xy\right)^3 \left(3xy\right)^2$

**16.** $\left(3mnp\right)^3 \left(mn\right)^4$

**17.** $\left(6w^2 x^5\right)^2$

**18.** $\left(-2n^5 pw^4\right)^3$

**19.** $\left(3x^3 y\right)^2 \left(2xy^5\right)^3$

**20.** $\left(2a^3 b^5\right)^3 \left(2a^6 b\right)^4$

**Answers**

1. $3^{12}$
2. $4^8$
3. $x^6$
4. $y^{11}$
5. $32a^6$
6. $-10b^9$
7. $t^{30}$
8. $m^{20}$
9. $x^9 y^{10}$
10. $y^{12} w^{35}$
11. $a^{14}$
12. $p^{32}$
13. $25a^2 b^2$
14. $27x^3 y^3$
15. $72x^5 y^5$
16. $27m^7 n^7 p^3$
17. $36w^4 x^{10}$
18. $-8n^{15} p^3 w^{12}$
19. $72x^9 y^{17}$
20. $128a^{33} b^{19}$